Other Resource Management Strategies

This section highlights a variety of water management strategies that have the potential to generate benefits that meet one or more water resource management objective, such as water supply augmentation, water quality enhancements. The overall message of this narrative is that there are potential water management strategies that have not been fully explored and may warrant further study. There are several reasons these strategies are not more fully developed. Some of these reasons are:

- Needs more research, trials or evidence
- Currently costs exceed the current ability or willingness of users to pay
- Emerging technologies
- Currently have a limited potential to produce water management benefits

A list of the strategies considered in this narrative is as follows1:

- Dewvaporation
- Fog Collection
- Rainfed Agriculture
- Transoceanic Water Bags

Dewvaporation (Atmospheric Pressure Desalination)

Dewvaporation is a specific process of humidification-dehumidification desalination. Brackish water is evaporated by heated air, which deposits fresh water as dew on the opposite side of a heat transfer wall. The energy needed for evaporation is supplied by the energy released from dew formation. Heat sources can be combustible fuel, solar or waste heat. The tower unit is built of thin water wetable plastic films to avoid corrosion effects and to minimize equipment costs. Towers are relatively inexpensive since they operate at atmospheric pressure.

Current Dewvaporation in California

Dewvaporation is still a developmental technology. Final demonstration project towers have been built and operated at ASU laboratories.
The Salt River Project and the ASU Office of Technology Collaborations and Licensing are currently sponsoring the Dewvaporation pilot plant program as an extension of grass roots support by the U.S. Bureau of Reclamation.

Potential Benefits from Dewvaporation

Dewevaporation can provide small amounts of water in remote locations. The basic laboratory test unit produces to 150 gallons/day. Eight of these units form a 1,000 gallon/day demonstration pilot plant of the Dewevaporation process.

Areas such as Yuma, Arizona and the desert regions of California could reclaim salt water at relatively low cost by taking advantage of their dry year-round climates.

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[1] Note that the quantity and specificity of information varies between strategies. This is solely due to the amount of information available to staff and does not make any inferences as to the relative efficacy of the strategies.

Potential Costs of Dewvaporation

The capital cost of 1,000 gallon/day desalination plant can range between $1,100 and $2,000. Operating costs range from $0.80 to $3.70 per 1,000 gallons distillate, or about $260 to $1,200 per acre-foot, depending on fuel source, humidity levels and plant size.

Major Issues Facing Dewvaporation

1. Cost and affordability
2. Small Scale
3. Concentrate disposal

Information Sources

- Beckman, James. R., Arizona State University, Tempe, Arizona, and U.S. Bureau of Reclamation. "Carrier Gas Enhanced Atmospheric Pressure Desalination." Final Report. October 2002.

Fog Collection

Precipitation enhancement also includes other methods, such physical structures or nets used in fog collection, to induce and collect precipitation.

Current Fog Collection in California

Precipitation enhancement in the form of fog collection has not been used in California as a management technique but does occur naturally with coastal vegetation; fog provides an important portion of summer moisture to our coastal redwoods.

Potential Benefits of Fog Collection

There has been some interest in fog collection for domestic water supply in some of the dry areas of the world near the ocean where fog is frequent. Some experimental projects have been built in Chile, and there has been consideration of such in some parts of the Middle East and South Africa. The El Tofo, Chile project yielded about 10,600 liters per day from about 3500 square meters of collection net, about 3 liters per day per square meter of net. Due to its relatively small production, fog collection is currently limited to producing domestic water where little other viable water sources exist.

Potential Costs of Fog Collection

The lowest costs for fog collection in Chile, where labor is much less expensive than California, were about $1.40 per 1,000 liters, or about $ 1,750 per acre-foot.

Information Sources

- Proceedings of the Second International Conference on Fog and Fog Collection, P.O. Box 81541 Toronto, Ontario, Canada, July 2001.

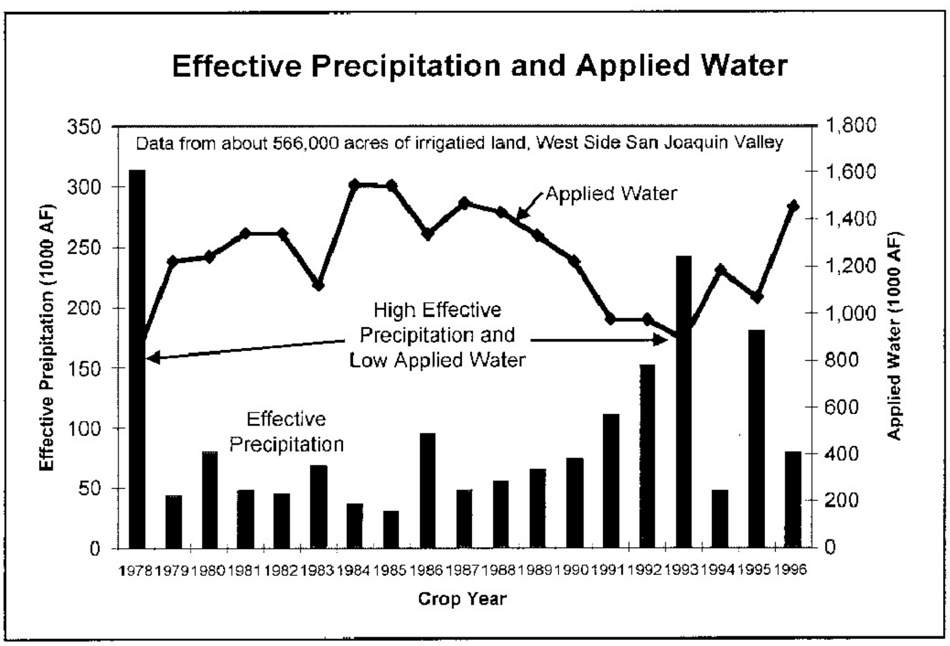
Rainfed Agriculture

Rainfed agriculture is when all crop consumptive water use is provided directly by rainfall on a real time basis. Due to unpredictability of rainfall frequency, duration, and amount, there is significant uncertainty and risk in relying solely on rainfed agriculture. This is especially true in California, where there is little or no precipitation during most of the spring and summer growing season.

Current Extent of Rainfed Agriculture in California

Climatic conditions in California provide excellent conditions for crop production; little cloud cover provides ample solar radiation during the spring and summer growing season. Precipitation in the form of rainfall and snow occurs mainly during the fall and winter months. However, the lack of sufficient and timely rainfall during the spring and summer in much of California severely limits the potential for expansion of rainfed agriculture.

In California's interior, north coast, and central coast, winter crops directly use rain water with the help of more irrigation water during the latter part of the winter season, if needed. These areas provide a relatively high return from the high value winter crops such as vegetables in the Costal areas. Other important agricultural production sectors that are dependent on rainfall are pastoral areas, rangelands, and rolling hills in the state. These areas produce significant amounts of feed and provide grazing areas for the state's large cattle (dairy and meet) industry. Winter small grains crops, such as winter wheat, account for about 4 percent (400,000 acres) of agricultural lands and provide a relatively small contribution to the state's total agricultural economy.



The vast majority of California's agricultural production requires irrigation. Rainfall that occurs before irrigation season and during the irrigation season can reduce irrigation water requirements. During years with heavy springtime rains, soil moisture remains higher for longer periods of time and can measurably reduce irrigation requirements for the year. Growers and water districts factor effective rainfall into their water management practices. In addition, DWR's water balance calculations for each region account for the portion of crop water requirements provided directly by rainfall.

As demonstrated in the figure on the previous page, applied water and rainfall events are closely related. More rainfall, particularly during early growing season, provides a significant quantity of effective rainfall for crop consumptive use. The figure shows the inverse relationships between effective rainfall and applied water. Based on the 18 years (1978-1996) of data for an area on the west side San Joaquin Valley, effective rainfall provided an average of 7 percent of the total crop consumptive use. In 1978 and 1993, two wet years with early season rainfall, effective rainfall amounted to 27 and 21 percent respectively of the crop consumptive use. In 1990, a dry year, effective rainfall amounted to only 3 percent of the total crop consumptive use. Similar examples can be given for other regions of the state.

Potential Benefits

Currently, improvements in the rainfed agricultural production offer limited water supply opportunity in California. More acreage for production of winter crops will reduce runoff flowing in the surface water systems and to ocean outflows. Improvements in rangelands and grazing areas through improved plant varieties can provide crop yield benefits but not significant water supply opportunities. One important aspect of improved rainfed agriculture is a better post harvest/ pre-planting soil management for winter crops such as wheat. Many winter wheat growers are already implementing adequate and prudent soil management practices for water and erosion management. Land that is tilled after harvest and left fallow in the fall and winter can cause the soil surface to seal with the first and second rainfall and increase runoff and erosion. Improved tillage practices, no-till or minimum-till, may improve water infiltration into soil root zone, thus increasing soil-water storage and could contribute to water supply by eliminating the first seasonal irrigation. Additionally, increased soil moisture reduces soil erosion; helps improve water quality and may help increase water use efficiency and economic efficiency. Advances in plant genetics to provide higher crop yields from direct rainfall could replace some crops that rely on irrigation.

Quantification of potential water savings from improved rainfed agriculture, while very small, is not possible due to lack of information.

Potential Costs

Potential cost consists of on-farm soil management and cost of research and development, demonstration and educational and training and dissemination of information and technologies. On-farm cost is an integral part of soil management that is already part of grower’s practices. Soil management practices may need to be adjusted for timing with no additional or minimal cost. Cost of research, development, demonstration, education, and training and dissemination of new information and tillage management technologies will need to be paid by the state. It is possible that such activities can be funded from CALFED Water Use Efficiency loans and grants.

Major Issues for Additional Rainfed Agriculture

While rainfed agriculture provides some opportunity for increasing yield and water supply reliability, the efforts will likely result in insignificant and unquantifiable contributions to the water supply. However, increases in yields for winter crops and winter cover crops can be significant and benefit overall water management in California. Water supply Improvements would require development of new varieties of plants, new and innovative soil and water management. A major issue is that quantification of water savings can not be made at the present time. Also, this strategy does not provide water supply benefits on a real time basis. For example, improvements in soil management may provide future benefit in storing more rainfall in the root zone if future uncertain and unpredictable weather conditions prevail.

Recommendations to Increase Rainfed Agriculture

Following is a list of recommendations to increase water use efficiency in the rainfed agriculture:

1. Develop improved varieties of winter rainfed crops, such as wheat, other small grains, cover crops, and winter crops. This can be achieved by providing financial resources to the state's research and development institutions to develop new and improved varieties. In addition, develop research and demonstration of innovative water management practices where growers with marginal lands and marginal production may shift from irrigated agricultures to rainfed winter crops.
2. Provide technical and financial assistance to promote no-till or minimum-till practices by growers who prepare their lands for planting during spring, but leave it fallow during the fall and winter. Cooperative efforts with the state's research and development institutions can benefit this important aspect of rainfed agriculture.
3. Develop new and innovative technologies, management, and efficient water management practices for rainfed agriculture, particularly winter wheat.
4. Provide technical and financial assistance to implement technologies, and management practices for rainfed agriculture.
5. Develop and promote new and innovative activities and management practices for intensive and managed grazing.
6. Maximize, collect, and store runoff from rainfed agriculture and develop cooperative efforts to link runoff from rainfed agriculture and water banking and conjunctive use activities and groundwater recharge.
7. Disseminate practical information through educational and training opportunities.

Information Sources

- Local agencies (reports and publications)
- Local farm advisors and UC System
- Federal Bureau of Land Management and National Forest Service
- Private rangeland owners and relevant associations of rangeland managers/owners
- United States Department of Agriculture, ARS
- State educational institutions (Fresno CIT, Cal Poly, etc.)
- Published technical and scientific papers
- California Cattlemen Association
- Commodity groups
- Ranches
- Information from best professional/scientific assessment/judgment of DWR's staff and others

Transoceanic Water Bags

The use of transoceanic water bags involves diverting water in areas that have unallocated fresh water supplies, storing the water in large inflatable bladders, and towing to an alternate coastal region. Fresh water is lighter than seawater, which makes the bags float on the surface. This makes them easier to tow. After discharging their contents, empty bags are then reeled to the deck of the tug allowing for a more speedy return to the source water area. Towing icebergs (frozen fresh water) is a variation of towing water bags.

Current Transoceanic Water Bag Use in California

Although this strategy is not currently being used in California, there have been several proposals to implement this technology throughout the world. The most recent is the proposal by Alaska Water Exports Company to divert up to 30 TAF from the Albion and Gualala River Rivers in Northern California and transport the water to the San Diego metropolitan area.

Potential Benefits of Transoceanic Water Bags

Freshwater supply augmentation

Potential Costs of Transoceanic Water Bags

Cost is contingent upon several factors such as water purchase cost, facility costs for diverting and off-loading water, environmental mitigation, administrative costs, cost to construct bags and towing costs. No published cost estimates have been found as of release of this draft.

Issues

Third-Party Impacts

Similar to any other type of transfer, impacts on the area of origin may occur. This includes projects that use “surplus” water and using water that is currently being put to a beneficial use. Other issues of concern expressed to proponents of recent projects include aesthetics and noise pollution from diversion facilities and the dissatisfaction within area of origin communities that others are exporting a local resource.

Environmental Impacts

Although most diversions take place near the mouth of a source river, facilities would need to be built to convey the water from a significant distance upstream (e.g. before blending with high salinity ocean water).